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## 5 Modular Universal Adapter Telemedicine System

The present invention relates to a modular universal adapter telemedicine system.

10 Known telemedicine systems usually comprise function modules,  
of which at least one is present at the patient's location,  
which can assume various tasks. In particular they serve for  
diagnostic, identification, communication or data transmission  
purposes between a patient or an assisting person, respectively  
15 and a physician's receiving and consultation center.

A modular designed telemedicine system uniting all  
aforementioned functions is for example known from the earlier  
German patent application DE 101 54 908.3. As regards the  
20 configuration of the function modules in this invention,  
reference is explicitly made to the earlier application.

Telemedicine systems are used in situations that require mobile  
device diagnostic examinations for physicians to make decisions  
25 regarding acutely ill persons, chronically ill persons and  
healthy persons. Such examinations, however, have not been  
possible until now due to various circumstances or required an  
unreasonably high degree of technical effort using the prior  
art. Such situations include for example mobile medical  
30 treatment of individuals or groups of persons abroad, direct  
treatment of chronically ill patients at their homes, as well  
as regular prophylactic self-examination by healthy individuals.

The present invention has the object to create a telemedicine system of the generic type that can be used universally.

5 This object is solved by a universal adapter telemedicine system with the features of claim 1. The system according to the invention comprises

- 10 a) function modules variable in number and function for diagnostic examinations, communication and identification;
- b) at least one universal adapter to connect the function modules to a
- c) process module to output, process and transmit data.

15 The combination of a universal adapter that is compatible with preferably all function modules variable in number and function on one hand and with the central process module on the other hand, represents a system that can be used in a very flexible manner, furthermore, unifies the "interfaces" required and thus  
20 can be realized in a cost-efficient manner. Especially, the small physical dimensions of the system components - universal adapter, function and process modules - benefit the mobile use of the telemedicine system. Telemedical treatment of persons is made possible by connecting the telemedicine system according  
25 to the invention to a physician's receiving center via the process module.

The particular design of the connection of the universal adapter and the correspondingly uniform configured connections  
30 of the function modules allow to connect each of the function modules to the universal adapter and thus to the process module in exactly the same way. The connections of the universal

adapter and of the function module are designed so that they can be intuitively connected correctly even by untrained persons, and that the plug connection is robust.

5 Furthermore, the universal adapter is preferably designed so that it allows basic, simplified operation of any function module connectable thereto in a uniform manner. To this end, the adapter has four control elements and a plurality of acoustic/visual signal elements as well as a function display  
10 and/or a display on its surface. The universal adapter reduces the basic control of various function modules, in particular of the diagnostic modules, to a two-knob control system. Only two of the four control knobs located on the surface of the universal adapter are required to record and transmit data and  
15 to inquire the status of preferably all function modules. Operation is supported by the visual signal elements (LED) and the acoustic signals as well as the function displays which signal the operating state and refer to the operating steps. This universal control system provided via the universal  
20 adapter permits inexperienced persons to immediately handle totally different function modules/diagnostic devices. All four control knobs can, beyond the basic operating functions, extend the operation or configuration, respectively of the universal adapter and the function modules. Operation can also be  
25 expanded to include both remote access by the physician's receiving center and by adequate process modules such as PCs or PDAs.

The function modules, of which at least one is available in the  
30 telemedicine system according to the invention, are generally hand-sized, transportable, medical measuring devices for recording medical diagnostic parameters such as

electrophysiological cardiac action, blood pressure, body temperature or oxygenation of blood. Just as the universal adapter, preferably all function modules also have a rechargeable accumulator. The modules are either used by the patient himself or on the patient by another person. Device-specific sensors record the measured values, which are then stored on non-mechanical storage elements in the device. All function modules are fully functional individual devices and can be used independent of the remaining components of the system. To this end, preferably all function modules have adequate control elements, in particular two, and acoustic/visual signal elements as well as a variable display and/or a function display on their module surface. Connecting the function module to a corresponding process module - preferably a mobile telephone - by means of the universal adapter allows the data to be transmitted to the physician's receiving center, and there the data is available to the physician for diagnostic and/or therapeutic decisions. As a general rule, the entire telemedicine system (function module, universal adapter, process module) is controlled in a simple manner by the universal adapter (Fig. 1). However, remote control by the physician's receiving center is also possible.

The following diagnostic function modules are possible candidates for integration into the system: an electrocardiograph, a pulsoximeter, a spirometer, a blood pressure manometer, a thermometer, a cardiotocograph, a heart beat monitor (event recorder), a blood sugar measuring device as well as other devices. The integration of additional modules into the system is decisively determined by the requirements for the design of the connection.

In addition to the diagnostic function modules, other forms of the function module exist in the telemedicine system. This includes a module for personal identification, for example. It is possible, by means of the module, to authenticate the person transmitting the data, to sign the data transmitted and/or to change the user mode (see below) using biometric processes (e.g. fingerprint, iris scan) or by reading identification cards, respectively. Expanding the telemedicine system to include such an identification module provides an advantage compared to identification mechanisms internal to devices in common use today - such as transmitting the phone number of the communication device or the device ID of the diagnostic function modules - in that the telemedicine system can also be used within groups of persons in a multi-patient mode and assignment of the measured data to individual persons is allowed.

Other potential function modules (communication modules) serve to record and transmit image, video and audio data. Transmission of this data to the physician's receiving center, in particular in real time, together with the medical data provided by the diagnostic modules allows the physician to make diagnostic and therapeutic decisions.

Furthermore, it is particularly preferred that the function modules comprise a locating module to determine the geographic position of the telemedicine system. This particularly can be a GPS module to determine and transmit geographic position data which, depending on the constructional design, can either be a separate function module or an integrated component of the universal adapter. This locating module makes it possible for the physician's receiving center to conduct an emergency

localization of the patient and, if required, to initiate and correspondingly guide rescue operations.

5 Basically, various mobile telecommunication devices as well as data processing and data output devices (PCs, printers, etc.) can be used as a process module. Thus, both a conventional GSM or GPRS mobile telephone, respectively and a UMTS or satellite telephone, respectively can be used for data transmission.

10 The modular design of the telemedicine system permits flexible use in various scenarios. The telemedicine system is equipped with function and process modules according to requirements. The medical requirements determine whether the system only contains a selected diagnostic function module to monitor the  
15 blood sugar for instance, or if it includes all available function modules, thus enabling a wide spectrum of device diagnostic examinations and comfortable audiovisual communication.

20 All function modules of the telemedicine system used are registered in the universal adapter and, if required, assigned to one or several patients. The function modules are automatically registered on the universal adapter when connected to the adapter.

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The telemedicine system according to the invention and in particular the universal adapter are operated in various user modes which differ with regard to the scope of the functions and with regard to the authorizations assigned to the various  
30 users or groups of users. In addition to the standard mode for the patient, the physician mode, the multi-patient mode and the remote access mode to control the system from the physician's

receiving center are available. Further modes can be configured. For safety reasons, the modes can only be switched over by the identification module or a process module, respectively (e.g. cellular phone).

5

As a general rule, data exchange between the function modules and the universal adapter as well as charging of the accumulators of the function modules is wirebound. The corresponding I/O connections on the sides of the universal  
10 adapter and of the function modules comply with a universal standard (e.g. the USB 2.0 standard). The transmission protocol used may be a standard internet protocol (e.g. TCP/IP). Depending on the equipment of the function modules, wireless data exchange - in particular Bluetooth or WLAN interfaces -  
15 between the function modules and the universal adapter may also be used. At the same time, one function module can be connected to the universal adapter wirebound or a plurality of function modules can be connected thereto wireless, respectively.

20 The connection of the universal adapter to the process modules can optionally be wirebound - via device-specific I/O connections - or even wireless (e.g. Bluetooth, WLAN).

By integrating adequate application software into the universal  
25 adapter, the system allows the generation and monitoring of diagnostic and therapeutic schemes, taking into account the function modules that are registered and thus available in the system. Thus, monitoring regular diagnostic measures - in form of medical monitoring - or taking medicine, respectively is  
30 possible by means of the telemedicine system.

There is a huge advantage to the system according to the invention when several telemedicine systems are used at the same time in that the universal adapters can communicate among each other. This enables the common use of individual process  
5 modules, for example. In this connection, data from the universal adapters to the process module is transmitted by a single common transmission path of a universal adapter. Thus, it is in turn possible to process or transmit a plurality of diagnostic data from different function modules at the same  
10 time by means of a process module (Fig. 2e).

The invention is described in detail hereinafter with reference to the accompanying figures, in which

15 Figure 1 shows the basic design of the modular universal adapter telemedicine system according to the invention,

20 Figure 2 shows various application possibilities of the individual system components,

Figure 3 shows the detailed schematic design of the universal adapter and the function module according to the invention.

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The telemedicine system 10 according to the invention has a modular design. Basically, it comprises three components, a function module 40, a universal adapter 20 and a process module 60. The telemedicine system 10 can connect to a physician's  
30 receiving center 80 via a wireless transmission path 90 by means of corresponding process modules 60 (Fig. 1).



The function module 40 is a module variable in function and number that either represents a medical diagnostic module for recording specified diagnostic parameters, an identification module for personal identification, an audiovisual communication module or a GPS module. According to a preferred embodiment, system 10 includes each of the aforementioned functionalities.

Medical diagnostic modules can include an electrocardiograph, a pulsoximeter, a spirometer, a blood pressure manometer, a thermometer, a cardiotocograph, a heart beat monitor (event recorder), a blood sugar measuring device or other measuring devices.

All function modules 40 are characterized by common technical features. For example, all devices have an identical, bifunctional connection 42/44 for the universal adapter 20, comprising an I/O connection 42 and a power connection 44 (Fig. 3). The module's internal accumulator 46 is charged by power connection 44, and the wirebound data transmission is effected by the I/O connection 42. Two control elements 56 are preferably located on the surface of the module to allow measurement operations. In addition, all function modules 40 have displays 58 that vary in shape and size to display measured values and/or to check functions. The diagnostic function modules have function-specific measurement sensors 48 to measure diagnostic parameters.

If the function module is designed as an identification module, the function module has a reader that reads biometric identification features (fingerprint, iris) or identification cards (not shown), respectively. Another function module 40

designed as a communication module and equipped with sensors to record acoustic and visual signals and having a larger color display and a loudspeaker serves audiovisual communication (not shown). An existing GPS module serves to locate the  
5 telemedicine system and can both be a separate function module 40 and integrated into the universal adapter 20 (not shown).

The universal adapter 20 has a bifunctional connection 22/24 to which the function modules 40 can be connected. Connection  
10 22/24 includes a universal I/O connection 22 (e.g., the USB 2.0 standard), via which data is transmitted wirebound to the function modules, and power connection 24 to charge the accumulator of the function modules 40. Data is exchanged with the process module 60 or with correspondingly equipped function  
15 modules 40, respectively by a wireless connection (e.g., Bluetooth, WLAN). Use of the module is preferably supported by four control elements 36 and function displays 38 on the surface of the module. Furthermore, the universal adapter 20 contains its own accumulator 26 so that it can be operated  
20 independent of the electric network. The accumulators 26 and 46 of the universal adapter 20 or of the function modules 40, respectively are charged using a charging cable 27 connected to the universal adapter 20.

25 The various application possibilities of the system are derived from the modular design of the telemedicine system 10. Thus, in addition to the direct use of the function modules 40 (Fig. 2a) via their control elements 56, it is also possible to connect all function modules 40 sequentially to the universal adapter  
30 20 and to operate them by means of the universal adapter 20 in an identical manner (Fig. 2b).

Such operation mainly includes basic operating steps, such as data recording, data transmission and status inquiries.

Furthermore, the use of the modular universal adapter  
5 telemedicine system as such includes wireless and wirebound  
connection of the universal adapter 20 to a process module 60  
(Fig. 2c or 2d, respectively). Thus, connection to the  
physician's receiving center 80 via a transmission path 90 can  
be accomplished by means of suitable process modules 60.  
10 Furthermore, wireless communication of universal adapters 20  
among each other allows the common use of individual process  
modules 60 present (Fig. 2e).

## 5 List of reference numerals

	10	Telemedicine system
	20	Universal adapter
	22	I/O connection (for example USB)
10	24	Power connection (for example USB)
	26	Accumulator
	27	Charging cable
	28	Wireless interface (WLAN/Bluetooth)
	30	Central processor
15	36	Control elements
	38	Function display
	40	Function module
	42	I/O connection (for example USB)
	44	Power connection (USB)
20	46	Accumulator
	48	Measurement sensor
	50	Central processor
	56	Control elements
	58	Display
25	60	Process module
	80	Receiving center
	90	Transmission path